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Petersen, Carsten Skotte

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An essay on the use of auctions over ITQ's

Carsten Skotte Petersen[1]

University of Copenhagen

Institute of Food and Resource Economics

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Abstract

This paper is an essay on ways of using auction as a mechanism for optimizing price settings. Auction theory is relevant for optimizing revenue in markets for private and common value goods. The paper is applying auction theory on auctions for fishing quotes. The benchmark analysis conducted on the auction markets is based on the principles of maximizing the revenue in auction based on the Revenue Equivalence Theorem (RET), which is central for designing optimal auctions. Dissolving some of the assumptions of the (RET) is a presumption to benchmarking different auction mechanisms under different market conditions. This paper discusses how auction theory might be used for analyzing markets for Individual Transferable Quotas (ITQ).

Key words: Pricing, Revenue Equivalence Theorem, auctions over fishing rights.

1. Introduction

The purpose and focus of the paper is to explain which auction mechanisms that gives the highest revenue of fishing rights. The resource rent gives an opportunity to secure another allocation of what could be a common good than today, without having an effect on the development towards an economically optimal fishery. Benchmarking of auction markets is founded on (RET)[2]. The benchmark model says, given assumptions of risk neutrality, symmetry and independent private values,

"*then different auction forms yield the same expected revenue, and also allows revenue ranking of auctions to be developed when these assumptions are violated*" (Klemperer 2004, 77).

The common fish resources are under pressure and policy makers have in some countries, for example in Denmark, introduced individual transferable quotes (ITQ) for securing a market based allocation of resource among fishermen. However, a proper designed auction system goes hand in hand with securing the highest revenue and obtaining efficiency in the fishing fleet. In a grand fathering system (administrative decision, giving the quotas away for free the resource rent is obtained by the fishermen) , while in a system were the public authority owns the rights over the TAC and auctioning those rights away, the public authority and thereby the society obtains the resource rent. Today the most common system is the grand fathering, where the objective is to maximize fishermens profit. Allocating government-owned fishing rights through an auction, the objective is to maximize the revenue because we want to maximize tax revenue.

[1] Email: csp@foi.dk Phone: direct +4535336888 press +4535336800

[2] Definition on page 2-3

The outline of the paper is as follow. In the following section is given an introduction of auction theory is made. Concepts and definitions are set place. In section 3 the theory is used for describing the optimal auction design based on the specific conditions characterizing the buyers (vessel owners) in ITQ's. In section 4 there is a discussion of thoughts of entry, collusion, size and time limitations of quotas, which is closely linked to the focus in this paper. Finally in section 5 a conclusion is made.

2. Auction theory

An auction is a market mechanism with a set of rules determining resource allocation and prices on the basis of bids from the market participants. The auction market is characterized by only having one seller and the auction theory goes on explaining ways for the seller to maximize market revenue.

The benchmarking is conducted based on the four auction types; English, Dutch, first sealed bid auction and second sealed bid auction (Philps 1988). The four standard mechanisms organization is explained. A mechanism is understood as rules for economic activity, meaning rules for how the agents react to different input, that is needed to be designed for example that the seller obtain the highest possible revenue. The outcome depends on the information of the agents (buyers and sellers) has. The auction mechanism used for obtaining the highest revenue depends on specific assumptions of the (RET). The benchmarking is done by dissolving (RET) assumptions, and then look at which of the auction mechanisms which generate the highest revenue.

The four standard auction types

The English auction type is based on the auctioneer setting a price of goods at a low level, then the buyers are given competing bids, which are rising in price to the price break. The auction ends when there is one buyer left and the final price is the remaining buyer's last bid. The essential feature of the English auction is that, at any point in time, each bidder knows the level of the current best bid.

The Dutch auction type is the opposite of the English. It is obtained by the auctioneer setting a high price for the goods, which is the stating price that price is higher than the price the buyers are willing to pay. Then the auctioneer lowers the price until the first of the competing buyers accept the auction bid.

In a first-price sealed-bid auction, potential buyers bid on the good by placing their bid in a sealed envelope. Whoever, has the highest bid wins the good and pay the price he has bid. The basic difference between the first price sealed bid auction and the English auction is that in the English auction, bidders are able to observe their rivals bids, whereas in the first sealed bid auction can if they choose, revise their own bids. In sealed bid auction one only submit one bid.

Second-price sealed-bid auctions are auctions with the same procedure as in first-price sealed-bid auction, and the winner of the good remains the buyer with the highest bid. The difference is that the winner only has to pay the amount equal to the second highest bid for the goods.

A benchmarking of the four auctions is founded on the Revenue Equivalence Theorem (RET), which outline under which conditions the four auctions types gives the same price (Vickrey, 1961).

The definition of the *Revenue Equivalence Theorem* (RET) is:

"*Assume each of n risk-neutral potential buyers has a privately known value*[3] *independently drawn from a common distribution F(v) that is strictly increasing and atomless on* $[\underline{v}, \overline{v}]$[4]*. Suppose that no buyer wants more than one of the k*[5] *available identical indivisible objects. Then any auction mechanism in which (i) the objects always goes to the k buyers with the highest values, and (ii) any bidder with value* $\underline{v}$ *expects zero surplus, yields the same expected revenue, and results in a buyer with value v making the same expected payment*". (Klemperer 2004, 42)

The (RET) says, given the assumptions hold, then it doesn't matter which of the four standard auction mechanisms are used to obtain the highest price as possible. But when some of the assumptions are not fulfilled, then one of mechanism is preferred over another that is, one mechanism is gives a higher revenue than the other auction mechanisms.

The (RET) applies both to private value models (in which the bidders value depends only on his own signal) and in common value models provided that bidders' signals are independent (Klemperer 2004).

The assumptions behind (RET) are:

a) A single seller[6] with reservation value v_0 faces *n* potential buyers, where buyer *i* holds reservation value v_i, *i* = 1,…..,*n.*

b) The reservation values[7] of the parties are independent and identically distributed, drawn from the common distribution[8] $F(v)$ with $F(\underline{v}) = 0$, $F(\overline{v}) = 1$ and $F(v)$ strictly increasing and differentiable over the interval $[\underline{v}, \overline{v}]$.

c) The agents are risk-neutral[9,10].

(Riley et al 1981, 381)

Besides these assumptions, it is assumed that in order to maximize revenue, then free entry and no collusion is an assumption. Further there exist uncertainties among buyers what the other buyers are willing to pay.

Uncertainty and auctions

In the auction market there is either private or common values. In the *private-value* model every buyer knows what the good is worth to them, but the buyer's valuation is private information, this means that the buyers cannot observe the valuation of the other buyers. Each buyer obtain the uncertainty that they do

[3] Each bidder knows how much he values the object for sale, but his value is private information to herself (Klemperer 2004)
[4] Every bidder are different regarding valuation, and this valuation are independently drawn from a distribution which is common knowledge to all bidders.
[5] k is a an expression for a number
[6] One of the features of auctions is the monopolizing that secures a higher price than in a perfect competition market, this is the case with the sale of ITQ.
[7] The bidders willingness to pay.
[8] Meaning that bidders are symmetric
[9] An example, could be that an agent which is indifferent between the risk of an outcome by lottery, and then a game with a certain outcome.
[10] This applies for both sellers and buyers

not know the highest bid that the other buyers are willing to give. A painting is a good example. In the *common-value* model, the value of the good is the same for all competing buyers. The uncertainty is based on that the buyer doesn't know the real value of the good. There is imperfect information of the value of the good, and each buyer has received an individual signal of the value, but the price signal is imperfect. This implies that the buyers are willing to follow a bidding strategy to bid what they think is a great likelihood what the other will bid, and they tend to over bid, this phenomenon is called the winners curse, meaning that they have paid more than the actual value. For example, the value of the rights to drill for oil depends on how much oil there is in the underground, and buyers may have access to different geological "signals" (these signals are distributed uniform) on this volume. In practice does the "pure common" model not exist, since the information differs among buyers. This is the so-called "true value", it is marginally different from buyer to buyer. There exist, a private-value component of the model. This is called the "almost common-value" model (Klemperer 1998).

3. Auctions used to allocate ITQ's

In the following it is discussed which assumptions funding the (RET) is most likely being found in markets for fish quotas. When one of these assumptions behind (RET) are not fulfilled, it is discussed which of the four standard mechanisms that maximizes revenue.

Dissolving of the (RET) assumptions, and preferred standard mechanisms

While both theoretical and applied economic literature on auctions is rich, studies of auctions over ITQ's are few. Nevertheless some papers have been made. Armstrong (2000) and Morgan (1995) discuss what happens when relaxing some of the assumptions in the (RET), and compares the different auction mechanisms.

Common values: The fishermen are uncertain what the true value of the ITQ's are but have private signals about this. Therefore, they are not sure what the actual value of the ITQ is worth to them. How does this affect prices in different auction mechanisms? In a sealed bid auction each bidder makes its own estimate of the true value of the good. The bidder who wins, is the bidder with the highest reservation value[11]. This means that all other bidders estimated value is lower. In a common value model, the winner's curse phenomenon arises. Winners curse means that the winning bidder has overestimated the true value of the good. A rational bidder in a common value sealed bid auction who wants to avoid becoming a victim of winner's curse, does this by believing that his own estimate of the good's value is higher than any other bidders. By believing that he is the winner, he sets his bid equal to what he estimates to be the second highest valuation, given that all other bidders make the same presumption. Thus, this same approach offers the English auction. So it makes no difference what kind of good it is. Therefore, one mechanism is not preferred over another (McAfee et al 1987), which is expressed in table 1 by outlining that the seller is indifferent in choosing between the four standard auction mechanisms, because all of them gives the same auction revenue.

It is more likely that bidders have *affiliated values*, that is, if a bidder believes the good for sale has a certain value, there is a substantial likelihood that other bidders have the same assessment. The English auction reveals information about the bidders for other bidders, which gives less information rent or asymmetry between bidders. This extra information reduces the risk of winner's curse, leading to more aggressive bids, leading to higher revenues. Therefore, the English auction mechanism is preferred from the seller's standpoint, if affiliated values are present (table 1).

[11] Willingness to pay

Risk-aversion: Buyers are risk-averse[12] where quota values are very high or when fluctuations of the fish stocks on an annual basis are large. Another argument is that the buyers of quotas (vessels owners) are risk averse follows due to the non-malleability of capital, leaving the vessel owners with only few options for buying quotas in other markets transferring the harvesting outside the national borders. Revenue tends to be larger in a first sealed price auction than in an English or second-price auction. This follows because
"But in a first-price auction, a slight increase in a players bid slightly increases her probability of winning at the cost of slightly reducing the value of winning, so would be desirable for a risk-averse bidder if the current bidding level were optimal for a risk-neutral bidder. So risk-aversion makes bidders bid more aggressively in first price auctions. Therefore, since the standard auctions were revenue equivalent with risk-neutral bidders, a risk neutral seller faced by risk-averse bidders prefers the first price auction to second price sealed bid or ascending auctions." (Klemperer 2004, 19)
A feature of bidding in auctions with risk aversion and a common-value goods, is the winners curse. The risk of winners curse is less than in an open auction. There exist a tradeoff between revenues and avoidance of winners curse. However, one can choose to make multiple rounds of sealed bid auctions, with the bids announced after a round, but not bidder identity. See table 1.

Asymmetry: Asymmetry is defined as observable differences between the bidders. In the ITQ case, it's a reasonable assumption to make that different fleet segments are asymmetric alia in their cost structure. See table 1. Given asymmetry exist, it implies that the conditions for (RET) is violated. The effect of pricing in different auction mechanisms is uncertain."*Roughly speaking, the sealed-bid auction generates more revenue than the open auction when bidders have distributions with the same shape (but different supports), whereas the open auction dominates when, across bidders, distributions have different shapes but approximately the same support*" (Maskin et al 1985,154).

Table 1 shows the assumptions behind the (RET). It is also about whether these assumptions are met in and auctions of ITQ's. The consequence is given by specifying which mechanism is preferable under the different assumptions.

Table 1. Preferred auction mechanisms by the seller if ITQ's are auctioned

Auctions over ITQ's	**Independent private values**	**No affliated values**	**Risk-neutrality**	**Symmetry**
(RET)	No	Yes	No	No
The (RET) is violated	No	Yes	Yes	Yes
Preferred mechanism from sellers point of view	Indifferent	English auction	1. sealed bid	Depends on bidders distribution

There is no absolute answer to the question of which auction mechanism that provides the highest revenue. As table 1 show, it depends on the fishery in question. Which of the assumptions of the (RET) are fulfilled. Morgan (1995) indirectly says that ITQ's are a common-value good, by writing about the winners curse. If one of the assumptions behind (RET) is not fulfilled, table 1 shows which mechanism is preferred when dissolving the assumptions behind the (RET) one by one. Other elements of importance are conditions of entry and collusion, which is discussed in further detail in the following section.

[12] Risk-aversion means that an agent prefers a game with a certain outcome, rather than a lottery.

4. Discussion and related thoughts about ITQ's

The revenue in the auction market is depending on the entry of newcomers and collusion. The entry is based on the ability of attracting newcomers into the market. Collusion is based on an agreement between bidders not to bid or bid low, which causes low revenue. Therefore these issues are important when the policy objective is to maximize revenue (Morgan 1995) (Bromley 2005). Furthermore the size and maturity of quotas are important, because it has to fit into the existing fishing fleet, while an immediately change in the fishing fleet is not practical.

Entry

Entry are important because as Klemperer (2004, 27) writes

"so it is typically worthwhile for a seller to devote more resources to expanding the market than to collecting the information and performing the calculations required to figure out the best mechanism"

One more additional bidder means that the revenue of the auction will rise. Therefore one has to look at what attract new bidders. Entry is also important securing the efficiency in fishing fleet.

Jensen et al (2005) discusses whether an auction over the Greenlandic shrimp fishery can achieve the policy object in terms of revenue maximization, when it is not realistic with new entry. The conclusion is that it becomes difficult to achieve. New entry is not realistic because of the dominant position on the market the two agents Royal Greenland (government owned) and Polar Seafood Greenland have. Another example of limited entry is seen in Estonian quota market (Vetemaa et al, 2002). The number and amount of quotas in auctions of the 10% of all Estonian fishing rights were settled by an auction committee. The fishery record was auctioning "open outcry"(English auction) of rising prices. In contrast of an English auction, in a first sealed bid auction, a weaker bidder may win at a price that the stronger bidder could have beaten and thereby, encouraged new entry. Each year, only one general auction was held over the Estonian open sea fishing (Vetemaa et al 2002). The auction mechanism offers two significant advantages. First, the process is efficient in that sense that it identifies the market demand and appropriate "price" for quotas. Second, the process identifies those potential users of the resource with the highest valuation for those fishing rights which are set for sale. This statement is tested in the paper of Eero et al (2005). They test the efficiency of different fleet segments in the year of 2001, where the Estonian auction system over ITQ's still was effective. The results of the quota auctions and their impact on the fleet structure are as follows. The results of the auction system, is similar as the ITQ systems in some other countries. First, the quota share of larger vessels has increased. Second, the concentration of auctioned quota to more efficient vessels has created the preconditions for eventual disappearance of less efficient vessels. The continuation of the auction system would probably have accelerated the process towards a more efficient fleet.

Collusion is important because it lowers the revenue due to weak competition among bidders. In an oligopolistic competition situation, where a homogenous good is produced, the threat of a future price war will be enough to encourage the single firm to take the monopoly price, instead of a reduction in price. Oligopolists are then able to cooperate without talking to each other. Firms have an incentive to collude if they: First, can identify an efficient dividing of the market. Second, can agree on a division of the market. Third, if drops from the agreement are easily discovered. Fourth, that punishing such a drop can be done with a great deal of credibility. Last, that firms scare firms that is not part of the collusion, from enter the market (Klemperer 1999). The choice between open or closed bid depends on the context. The advantage of the open auctions is that they do competitors valuation ratios of the quota for sale, available immediately. The bidders are more secure and offer higher and thus more revenue than a sealed bid auction. The exception to this is, when bidders are risk averse. Risk aversion exists when quota values are

very high, or fish from year to year varies greatly. Open auctions also has it flaws. For example, it is weak against collusion, which can lead to monopolistic practices, and hence lower quota prices. Collusion risk can be combated in a sealed bid auction. This leads usually to lower revenue because the bidders are trying to avoid winner's curse. This tradeoff between high revenue and the avoidance of collusion can be avoided by multiple rounds of sealed bid auctions. The next question is whether the auction should be a first, or a second price auction. In the first price sealed bid, there is a risk of winner's curse, so the winner will not be able to use quotas revenue. To protect against winner's curse, you can use the second price auction mechanism. An alternative to solving the winner's curse, is a one-price auction, where bids are accepted simultaneously. However, one design is not a good design in all situations. A practical example of collusion was the fish quota auctions in Estonia, held in 2001 and 2002. 2001 was a success regarding revenue maximizing. But in 2002 the fishermen managed to make an agreement, which caused the auction to break down. Later that year another auction was held over some quotas which was “leftovers”, and this time there was competing bidding, meaning that the fishermen agreement was broken. In 2003 the agreement between the fishermen consisted. And this was the end of the auction system in Estonia.

Size of quotas, matching the fleet capacity

The size of quotas matters when maximizing revenue, because a rapid change in fleet capacity in response to changes in the quota market is undesirable and not practical. If the quotas are too small it’s not efficient to a large vessel to bid, otherwise if the quota is to big then capital cost can achieve the benefits of owning a quota, then again no vessel owner will bid. While simultaneous auctions of quota units are preferred, in order to achieve a match between the quota and fleet capacity. Such auctions with multiple rounds of sealed bids, the bidders ability to use information disclosed during the bidding process, makes it easier to design unit aggregations to match capacity. This will affect investment decisions (Morgan 1995).

Time limited individual quotas (ISQ) versus ITQ’s

Exchange of quotas in the auctions will generate revenue, the actual resource rate that the fishermen are willing to pay to the quota owners. Owners may be the government, fishing communities, etc. The competition for quota among fishermen provides an incentive to improve efficiency and thus increase the margin between cost and market value. Shortcomings in a free market auction of the limited TAC might be that the social costs may be higher than what is politically acceptable. Governments role is to establish rules that enhance the free market and prevent monopoly (Trondsen 2002). ITQ's are auctioned to last long.

ISQ (Individual seasonal quotas), fits better into the fishermen’s planning horizon. Uncertainty characterizes fisheries and fishermen's planning horizon, it tends to be short term. As in ITQ's will ISQ system give fishermen and fishing firms an incentive to be competitive within the regulatory framework. It is in the fishermen’s own interest to minimize their overcapacity. Each season the ISQ’s are auctioned, otherwise ITQ's are auctioned only once. Beside it gives the fishermen a better opportunity to plan, other advantage of the ISQ is that, compared with ITQ, it could attract some newcomers as it does not require as much capital, and then prices of quotas are raised. But the risk of "deep pockets" exists. The risk is that capital-strong buyers buy quotas in order to eliminate competitors and to reduce future competition. This type of behavior can be minimized if fishermen get credit (Trondsen 2002). But the risk of this behavior is ceteris paribus higher in ITQ system than in ISQ system. Another weakness of the ITQ system is its ability to assemble all of the future resource rent. It is difficult to make real long-term projections of future quota value. This is much easier in ISQ system. In an ITQ system, the trade in allowances on the secondary market

may not give the resource interest to the community, but for fishermen and fishing firms, this may be a problem in allocation policy, and not meet the society's object function.

5. Conclusion

This paper has discussed some of the existing literature on the subject of auctions on fishing rights. The central theorem in auction theory is the (RET), in this paper the assumptions of the (RET) has been dissolved. The conclusion is that the (RET) does not hold. This implies that one auction mechanism can be preferred over another when the (RET) assumptions are dissolved one by one.

In addition to the theoretical concerns, what really matters in good auction design, besides the (RET) assumptions, are issues such as collusion and entry.

It has been shown by benchmarking different auction mechanisms, when one of the assumptions of (RET) is dissolved, then one mechanism can be preferred over another. This conclusion is on a theoretical level, empirical there is still a lot work to be done.

It has also been shown that auctioning fishing rights, secures that those fishermen with the highest valuation gets the rights. This is shown, both in a theoretical and practical way. This lead to a more efficient fishing fleet, which in reality, also has been the case in Estonia for instance.

5. References

Armstrong, C.W. 2000. *Why Fish Auctions Differ – Theory and Practise*. IIFET 2000 Proceedings

Bromley, D.W. 2005. Purging the frontier from our mind: Crafting a new fisheries policy. *Reviews in Fish Biology and Fisheries*. 2005:15:217-229

Eero, M., Vetemaa, M. and R. Hanneson. 2005. The Quota Auctions in Estonia and their Effect on the Trawler Fleet. *Marine Resource Economics*. 2005:20:101-112

Jensen, O.F., Jensen, M.H., Martinsen, B., Vestergaard, N. and C. S. Jørgensen. 2005. *Omsættelige kvoter og andre metoder til regulering af rejefiskeriet.* Rapport fra "Det uvildige udvalg", nedsat af Grønlands Hjemmestyre

Klemperer, P. 1998. Auctions with almost common values: The "Wallet Game" and its applications. *European Economic Review* 1998:42:757-769

Klemperer, P. 1999. *Auction theory: A Guide to the literature.* http://paulklemperer.org/

Klemperer, P. 2004. Auctions: Theory and Practice. Princeton University Press

Maskin, E.S. and J.G.Riley. 1985. Auction Theory with Private values. *The American Economic Review*. 1985:75:150-155

McAfee, R.P. and J. McMillan. 1987. Auctions and bidding. *Journal of Economic Literature*. 1987:25:699-738

Morgan, G.R. 1995. Optimal fisheries quota allocation under a transferable quota (TQ) management system. *Marine Policy*. 1995:19:379-390

Phlips, L. 1988. *The economics of imperfect information*. Cambridge University press

Riley, J.G. 1989. Expected Revenue from Open and Sealed Bid Auctions. *The Journal of Economic Perspectives*. 1989:3:41-50

Riley, J.G. and W.F. Samuelson. 1981. Optimal Auctions. *The American Economic Review* 1981:3:381-392

Trondsen, T. 2002. *TOWARD MARKET ORIENTATION: THE ROLE OF AUCTIONING INDIVIDUAL SEASONAL QUOTAS (ISQ).* XIV EAFE Conference I FARO, Portugal 2002

Vetemaa, M., Eero, M. and R. Hanneson. 2002. The Estonian fisheries: from the Soviet system to ITQ and quota auctions. *Marine Policy*. 2002:26:95-102

Vickrey, W. 1961. Counterspeculation, Auctions, and competitive Sealed Tenders. *The Journal of Finance* 1961:1:8-37